

SBC LEC TECHNICAL PUBLICATION

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SECTION 12--POWER SYSTEMS

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1. GENERAL

1.1. Introduction

- 1.1.1 This section covers the general requirements for engineering of battery/rectifiers (AC/DC), converters (DC/DC), inverters (DC/AC), Uninterruptible Power Systems (UPS), power systems monitor/controllers, AC/DC power distribution, ring, tone and cadence plants.
- 1.1.2 Changes in this issue of Section 12 are summarized in Table 12-1.
- 1.1.3 The Detail Engineering Service Provider (DESP) shall ensure that the manufacturer's specifications and documentation (i.e., electrical, mechanical, and maintenance documents, drawings, etc.) are provided with power equipment for turnover to local maintenance forces.
- 1.1.4 The DESP shall coordinate with the SBC LEC Equipment Engineer for the provisioning of the manufacturer's recommended spare parts for each type of power equipment. The SBC LEC

Engineer will work closely with the LFO in provisioning adequate spare parts based on the geographic response area.

- 1.1.5 The DESP shall provision alarms for all new power equipment in accordance with SBC-TP-76450 or SBC 801-601-900 SBC Alarm Standards Practice.
- 1.1.6 The DESP shall ensure all floor drains in engine or power rooms are permanently sealed prior to installation of equipment, via a specific installer note in the detail specification.
- 1.1.7 When adding equipment on waterproof floors the DESP shall determine the method of securing equipment frames to the floor in accordance with BSP 800-000-101MP

1.2. Compression Connections for DC Power

- 1.2.1 All connectors, including all approved transitional devices, shall be constructed of tin plated copper. Connectors with inspection holes shall be used in all applications except battery posts and connector plates.
- 1.2.2 Transitional Devices require a UL listed cover and must meet the fire resistance requirements of SBC-TP-76200. Covers shall have an oxygen index of 28% or greater and meet UL 94-V1 or better rating. AQUA-SEAL pads are not approved for use in SBC LEC.
- 1.2.3 In-line reduction (barrel) taps shall be used in preference to H-taps where possible to reduce cable build-up on the cable racks. The manufacturer provided clear heat shrink shall be installed per the manufacturer's instructions to cover the in-line reduction tap.
- 1.2.4 Lead coated connectors shall be used when connecting directly to posts or battery post termination plates of flooded type lead acid batteries. Lead coated connectors shall not be used for any other applications.
- 1.2.5 Manufacturer inspected and sealed battery connection kits (for non-flooded cells) with heat shrink tubing may be provided. These kits may have inspection holes as long as they are covered with heat shrink tubing.
- 1.2.6 For flooded lead acid batteries, cell post hardware shall be stainless steel, grade 316 and marked 316 accordingly. Washer thickness shall be 1/8 inch and the washer must rest completely on the tongue face of the post/terminal plate connector. Use the battery manufacturer's recommended bolt size for post connections.
- 1.2.7 Valve Regulated Lead Acid batteries shall use connectors other than lead coated.
- 1.2.8 On a going forward basis, NiCad battery connections shall be tin plated copper lugs without inspection holes and nickel plated steel hardware. If inspection holes were previously used, the hole shall be filled with Nox-Rust X-110.
- 1.2.9 The NiCad battery hardware supplied by Saft® shall be used, as standard metric threads are not compatible with the Saft® NiCad battery connections.
- 1.2.10 All connectors shall be the two (2) hole crimp type lugs (#8 stranded and larger) except when connecting to a stud in a power bay or when the equipment specification drawing requires a single hole lug. Single hole lugs require lock washers, except when connected to a fuse stud, in which case two (2) flat washers are required. These washers shall be provided as

specified by the equipment manufacturer. (See SBC Standard Drawing SBC-P-05100-E on the WoodDuck Web Site, <http://woodduck/> under Standard Drawings – SBC CO for assembly details.)

- 1.2.11 Connections made to screw type terminal blocks with #10 to #26 wire gauge shall be made using the correct color coded insulated ring-type connector, such as the T&B STA-KON or Burndy VINYLUG. The proper size connector shall be used for the wire size being terminated as detailed in the manufacturer's specifications.
- 1.2.12 New power plant installations with ultimate capacity of 4000 amps and above shall use copper bus bars. Existing plated or unplated aluminum bus bars may be connected to copper bus bars. No new aluminum bars shall be used.
- 1.2.13 Aluminum bus bars and non-hardened copper bus bars shall not be tapped for fastening terminal lugs; through bolts shall be used.
- 1.2.14 For all electrical connections, except for battery post connecting hardware, the DESP shall provide zinc plated SAE J429 Grade 5 or ASTM B99 silicon bronze finished bus bar joint, fastening and support bolts, nuts, washers, etc.. The hardware shall be American National Course with a Class #2 Fit.
- 1.2.15 When fastening bar to bar, bus bar clamps shall be used. A palnut or locknut shall be provided on each bus bar clamp bolt.
- 1.2.16 Ferrous bolts, screws, nuts, washers, bus bar supports and clips shall be zinc or cadmium plated for non-electrical connections.
- 1.2.17 Only American Standard Unified National Course (UNC) threads and hardware shall be used on all external power plant and bus bar connections (internal manufacturer power plant connections may be metric as long as there are no requirements for field installation interaction).
- 1.2.18 Exposed energized bus bar arrangements located outside of the power equipment areas, shall be protected with insulating (e.g., Lexan) covers meeting the oxygen index of 28% or greater. In power rooms or in power board lineups containing power exclusively, insulated covers are not required.

2. BATTERY/RECTIFIER (AC/DC)

2.1. General

- 2.1.1 This unit covers requirements for battery/rectifier systems utilized within regulated telecommunications facilities.

2.2. Rectifier Plants

- 2.2.1 The major components of the power distribution plant and rectifier plant (see Figures 12-1 and 12-2) are:

- a) LOCAL AC POWER DISTRIBUTION - Includes a dedicated Power Distribution Service Cabinet (PDSC) connected to the essential bus, conduit, cabling, fasteners, and protective equipment.
- b) CHARGING EQUIPMENT - Consists of rectifiers and associated equipment to convert AC power to DC power at voltages suitable for SBC LEC applications.
- c) STORAGE BATTERIES - Provides a source of DC power to the equipment when AC is not available, or until the AC can be restored. They also provide filtering of the rectifier output.
- d) DISTRIBUTION CIRCUITS (Primary, Secondary)
 - 1. Primary Distribution circuits originate at the power plant and terminate at a secondary distribution point or at specific equipment locations (Protected Circuit). It contains a power board that houses the first overcurrent protection devices and the downstream power distribution network that feeds the secondary distribution.
 - 2. Secondary Distribution is an intermediate protection network between the primary and the load equipment. It originates at a distribution point (i.e. BDFB, SPDU, or other similar distribution points) and terminates at a specific equipment location (Protected Circuit).
 - 3. All new Transport and Switching installations require Secondary Distribution and shall include an exclusive fused distribution source (i.e. BDFB, mini BDFB, micro BDFB, or Intermediate PDU) for secondary loads (network elements) if one does not exist.
 - 4. New/updated power plant installations shall include an exclusive fused distribution source (i.e. BDFB, mini BDFB, micro BDFB, or Intermediate PDU) for secondary loads (network elements) if a Secondary Source does not exist.
 - 5. This new Secondary Distribution source shall not be located in the traditional power plant footprint. The secondary distribution network contains a bay or panel that houses the overcurrent protection devices, and the downstream power conductors to the load equipment. Further more, Secondary distribution (i.e. BDFBs, SPDU's) may also feed smaller downstream distribution panels following a branch feed style of architecture (i.e. Fuse panels).

Primary and secondary circuit protection devices shall be coordinated to prevent premature operation of primary fuses caused by faults on secondary circuits. This coordination allows for circuit protection closest to the network element to activate first, in the event of a failure. When calculating individual circuit design, there should be approximately 20% difference in size between one point of circuit protection to the next.

e) DISTRIBUTION CIRCUIT COMPONENTS

DC distribution systems consist of three basic components:

1. Circuit protection device
 2. Battery and battery return conductors
 3. Terminating hardware at the circuit's origin and equipment end.
- f) **CONTROL VOLTAGE** - Is the voltage used to operate alarm relays and control circuits in the power plant. The voltage of the primary plant (48 volts, if available) will be the control voltage.
- g) **FLOAT VOLTAGE/PLANT VOLTAGE** – the plant voltage shall be read at battery string "A" This is the source of the SBC plant voltage as read at the controller.
- 2.2.2 Rectifier DC power connections from both supply and return shall utilize crimp type copper connections. Aluminum connectors are not acceptable. Power connectors shall be configured as follows:
- a) Within the supplier's equipment, power connections shall be configured to meet the manufacturer's requirements.
 - b) Between the supplier's equipment in the bay and the top of the bay, connections shall be two-hole crimp with the inspection window to verify the connection is fully engaged. Approved connectors can be found on the SBC Minor Materials list
- 2.2.3 AC feeders to rectifiers shall be enclosed in metallic conduit, raceway or bus duct. Vertical runs of Jacketed Metal Clad (JMC) cable or Liquidtight conduit shall only be used on the last three feet of the connection to the rectifier.
- 2.2.4 Metallic conduit (rigid, intermediate metallic conduit (IMC) and electrical metallic tubing (EMT)) is acceptable if it is not installed on cable racks. If EMT is used, compression couplings and junction boxes shall be used; set screw type couplings are not acceptable.
- 2.2.5 Rectifiers shall be designated G1, G2, G3, G4 ...Gn.
- 2.3. Batteries**
- 2.3.1 Flooded lead acid or Nickel-Cadmium (NiCad) batteries are the SBC standard for traditional network CO installations. Alternative battery technologies shall require a one-time approval (OTA).
- 2.3.2 The DESP shall provide the intercell connectors and associated hardware recommended by the battery manufacturer.
- 2.3.3 At the direction of the SBC LEC Power Engineer, the float voltage of the DC plant may be raised from 52.08 V to 52.80 V with the addition or replacement of flooded lead acid battery strings.
- 2.3.4 The NiCad battery strings for Central Office applications contain 38 (1.43V) cells that shall have a string float voltage measured at 54.4V for optimum performance. The float voltage can be reduced to 1.42 volts per cell (54.0 string float) if there is an adjustment issue with high voltage alarms.

- 2.3.5 The higher than normal NiCad 54.4V float voltage requires that a power plant be entirely supported by NiCad batteries. Strings of other battery types and float requirements such as flooded lead acid batteries shall not be mixed with NiCad battery strings in the same power plant.
- 2.3.6 Recommended alarm points for the 54.4 float are: Very High Voltage – 56.0V; High Voltage – 55.5V; Low Voltage – 52.0V; Very Low Voltage – 48.0V.
- 2.3.7 NiCad battery racks shall have sliding shelves, and shall meet the seismic rating for the geographical area.
- 2.3.8 NiCad batteries can release hydrogen gas, and the same safety precautions regarding gassing and explosion hazard apply to NiCad as flooded lead acid battery installations.
- 2.3.9 NiCad batteries contain a corrosive alkaline electrolyte solution that shall be neutralized with a special NiCad spill kit (which is labeled in bright orange). A NiCad spill kit shall be ordered for the first installation of NiCad batteries in an office area. The installation vendor is responsible to provide a NiCad spill kit during their battery installation activity. (Spill kits for flooded lead acid batteries do not contain the correct neutralizing absorbent for NiCad batteries, and the lead acid battery safety equipment shall not be used when cleaning up a NiCad electrolyte spill due to the potential of a dangerous chemical reaction.)
 - a) DESP shall include a Specific Installation Supplier Note to insure spill kits shall be left on-site.
- 2.3.10 NiCad batteries shall use constant voltage charging to maintain float voltage. Temperature compensated voltage control for VRLA application is not recommended.
- 2.3.11 Additional details regarding NiCad batteries can be found in SBC Standard Power Drawing – SBC-P-05330-E..
- 2.3.12 Plastic battery stands used for round type lead acid cells shall be provided with earthquake rated floor mounted corner details in zone 3 and above.
- 2.3.13 When engineering new battery plants the DESP shall provide approved spill kits.
 - a) DESP shall include a Specific Installation Supplier Note to insure spill kits shall be left on-site.
- 2.3.14 Battery spill containment shall be provided on a site by site basis according to local code mandates and/or direction of the Fire Marshall.
- 2.3.15 When engineering flooded lead acid battery installations, cells of different manufacturers shall not be placed in the same string.
- 2.3.16 Battery strings of the same float voltage (including alternative technologies, e.g. flooded lead acid and lithium) may be placed in parallel.
- 2.3.17 Cells of different battery technologies shall not be placed in the same string.
- 2.3.18 When engineering the replacement of individual cells in a string, the cells provided will have the same ampere-hour capacity, the same number of plates and will be of the same manufacturer.

- 2.3.19 Measured at floor level, a minimum distance of 36 inches shall be maintained between a battery rack, equipment, rigid spill containment, and non-movable obstructions.
- 2.3.20 A single row rack parallel to a wall shall be a minimum of 8 inches from the wall. One end of the battery stands can be placed perpendicular to the wall within 8 inches.
- 2.3.21 The DESP shall provide a thermometer for each battery string installed which may be included in a battery accessory kit.

2.4. Cable And Bus Bars

- 2.4.1 Whether cables or bus bars are used, each type of conductor shall be sized per Table 12-1 taken from SBC 790-100-656, "DC Power Distribution", to prevent heating or exceeding the voltage drop requirement.
- 2.4.2 4/0 flexible type power cable shall be the standard size and type to be used on all flooded lead acid cells through 1800AH on battery tier-to-tier or tier-to-termination bar applications. Size 350kcmil, flexible type power cable, shall be used on 1801AH to 4000AH cells.
- 2.4.3 Size 2AWG flex power cable shall be used to connect 125AH NiCad battery strings shelves to the rack battery and return bus bars (collection bars). The use of the 2AWG flex power cable allows easy movement of the shelves for battery servicing.
- 2.4.4 All bus bars shall be 95% hard drawn copper, bare or tinned.
- 2.4.5 All connections to a bus bar shall be made with a two-hole crimp type connector only. See Drawing SBC-P-05100-E.
- 2.4.6 Cables from the rectifiers to the batteries and from the batteries to the discharge panel shall be on dedicated, non-fused cable racks, that are designated accordingly.
- 2.4.7 AC branch circuits shall be enclosed in non-flexible metallic conduit or raceway. Metallic Armored Clad (MAC) cable may be used only when factory installed within bay end guards, and AC outlet extensions between bays, within the base of the bay.
- 2.4.8 For network equipment applications where rigid conduit connections are not practical, Jacketed Metallic Clad (JMC) conduit enclosed cable may be used, but shall be limited to three feet or less. Per the NEC, equipment connections shall be limited to three foot maximum of JMC; light fixture connections shall be limited to six foot maximum of JMC.
- 2.4.9 In remote terminals or remote switching locations where multiple cable racks are not generally available, the following guidelines will be used:
 - a) Cable rack "power cable brackets" mounted to the cable rack at nine inch intervals may be used for all fused power cables.
 - b) As an alternative, cables can be run on the same cable racks as switchboard cables, if segregated.

3. CONVERTERS (DC/DC)

3.1. Introduction

- 3.1.1 This unit covers DC/DC converters, which transform the DC output of a battery plant to other DC voltages. The converter output voltage may be higher, lower, or at a different polarity than the input voltage. In some special cases, where ground or transient isolation is required, the output voltage may be the same as the input.
- 3.1.2 DC/DC converters that are placed for equipment isolation should be physically located in close proximity to the served equipment.

3.2. Requirements

- 3.2.1 Individual and total fusing capacity shall be limited so the converter plant will be capable of operating any discharge fuse when required. This requirement shall be met without the redundant or working spare converter in service. It is also acceptable to use a capacitor bank, which is designed to provide additional short-term capacity to operate discharge fuses.
- 3.2.2 Individual battery returns shall be run for battery discharge circuits.

4. INVERTERS (DC/AC) AND UNINTERRUPTABLE POWER SYSTEMS

4.1. General

- 4.1.1 If the AC load is identified as "protected", it shall be fed from an inverter plant or Uninterruptible Power System (UPS), as determined by the SBC Equipment Engineer. The use of inverters should be considered as first choice.
- 4.1.2 An AC maintenance bypass switch from a separate commercial AC power source to the inverter/UPS output PDSC shall be provided to allow maintenance or removal of the protected AC element on UPS and inverter systems larger than 10KVA

4.2. UPS Apparatus Considerations

- 4.2.1 AC wiring shall be sized to meet manufacturer's specifications or NEC specifications, whichever is more stringent.
- 4.2.2 Rigid metallic conduit shall be used in areas where activity could jeopardize the integrity of the system.
- 4.2.3 Circuit breakers shall be sized and coordinated with system components to ensure proper isolation of feeders due to faults or overloads. Breakers shall be sized to allow all charge units to operate at full output during battery recharge.
- 4.2.4 DC wiring shall be sized to meet manufacturers' specifications for ampacity and loop loss between the battery and the charger or inverter.
 - a) These leads shall be run on open cable racks or trays. Conduit may be used if both the positive and negative leads are run in the same conduit. Conduit should be used only if other means are not available due to space requirements.
- 4.2.5 Computer systems shall have electrically operated remote disconnection devices as detailed in Section 14 of SBC-TP76400. They shall be located in the computer room and not in the UPS area.

- 4.2.6 Grounding of the UPS shall be in accordance with the manufacturer's specifications and Section 13 of SBC-TP-76400.

5. RING, TONE AND CADENCE PLANTS

5.1. General

- 5.1.1 This section provides general information regarding:
- a) Ringing systems currently in use in switching and transmission systems;
 - b) The various call progress tones furnished by ringing plants;
 - c) General information on ring plant sizing.
- 5.1.2 Going forward, ring cadence and voltage of any type should be generated within the equipment
- 5.1.3 In Stored Program Control System (SPCS) offices, ringing, call progression tones, precision tones, Dual Tone Multi-Frequency (DTMF), dial tone, audible ringing tone, high tone and low tone, are provided by the switch. A separate ringing plant shall be provided for all non-switched services such as Foreign Exchange (FX), ring down, Interexchange Carrier (IC) special ringing requirement, metallic facility, etc.

5.2. Ringing Systems

- 5.2.1 Some non-switched circuits will require a ringing supply. Generally, non-switched circuits only require 20 Hz, AC/DC Superimposed ringing. Ringing supplies for non-switched circuit shall be separate from the ringing supply for the SPCS equipment.
- 5.2.2 The major ringing and tone components of the plant shall be provided with a redundant configuration.

5.3. Residual Ringing Plant - Ringing and Tone Distribution

- 5.3.1 The signals generated by a ringing plant are fed from fuses mounted on the main ringing power board. These main fuses in turn feed other distribution bays or equipment fuse panels. The downstream fuse shall in all cases be smaller than the upstream fuse. The DESP shall verify with the SBC LEC Equipment Engineer that distribution fusing does not exceed the maximum output current of the ringing supplies.
- 5.3.2 The DESP shall verify with the SBC LEC Equipment Engineer that adequate fusing is provided on each ringing supply path when adding new equipment fed by the ringing supply.
- 5.3.3 Ringing plant distribution fuses shall not be multiplied to more than one fuse bay.

6. DC POWER DISTRIBUTION

6.1. Power Distribution Sources

- 6.1.1 Fuses are preferred for primary distribution equipment. Circuit breakers may be used for circuits with design requirements less than 226 amps. Fuses are required for circuits with

design requirements of 226 amps or larger. Fuses are considered the preferred method of circuit protection.

- 6.1.2 Equipment being engineered with multiple loads (i.e. "A", "B", "C", etc.):
 - a) shall be assigned to different load supplies on the BDFB.
 - b) shall maintain separate primary fuse integrity throughout the circuit
- 6.1.3 Primary battery and battery return leads shall be run on unpanned dedicated power cable rack. Secondary power leads shall be run on existing, dedicated secondary power cable racks, whenever possible. If dedicated cable rack is not available, secondary power leads shall be run on existing non-dedicated cable rack.
- 6.1.4 A separate battery return lead shall be paired with each distribution or source lead. A and B battery return leads may be connected to the same battery return bus bar position.
- 6.1.5 The DESP shall provide 145P (tag) or approved equivalent tags for both ends of every battery and battery return lead, except secondary power leads internal to a rack or voice switching system.
- 6.1.6 Preferred fuse panels for BDFBs are telecommunications power-style (e.g. TELPOWER®), which accommodate fuse sizes from 1 to 150 amps.
- 6.1.7 The maximum fusing for a supply to a single or multiple bay BDFB shall be sized to the bus distribution, not to exceed 800 amps per load, unless prohibited by the state commission.
- 6.1.8 On a going forward basis, the DESP shall provide a work item to designate the manufacturer's maximum BDFB shunt capacity on the front of the BDFB.
- 6.1.9 The largest fuse to be used in a BDFB shall be 150 amps.
- 6.1.10 In a BDFB, a single panel shall not have multiple feeds connected to it.
- 6.1.11 Only factory manufactured 45 or 90 degree lugs shall be used to minimize cable congestion within the BDFB.
- 6.1.12 Any secondary distribution equipment located on one floor shall not be used to supply equipment located on another floor, except in those cases where requirements state that equipment units must be supplied from the same secondary distribution equipment and the equipment units are located on different floors.
- 6.1.13 For new BDFBs configured with external battery return bus bars, the bars shall be mounted as close as possible to the BDFB without impeding the access to the BDFB or associated cable racks. The preferred placement for the external return bar is at the rear of the BDFB at the cable rack level or higher; however, it can also be placed to the side of the BDFB, at the cable rack level or higher, based on space availability. (see figure 12-3 in this section for BDFB external battery return bar placement, and Section 8 figures for common systems cabling and rack details.)
- 6.1.14 SPDUs (Secondary Power Distribution Units) are designed to provide a centralized location for other equipment to obtain power of small amperages. SPDUs are provided with power from a BDFB or Power Board.

- 6.1.15 The use of legacy miscellaneous fuse bays shall be discontinued as bay mounted fuse panels shall be the source of secondary distribution.
- 6.1.16 SPDUs shall be fused at their source (BDFB, Power Board) with a fuse size not to exceed the maximum rating of the fuse panel.
- 6.1.17 Every SPDU shall be fed individually from the power source (either from a BDFB, distribution panel or intermediate PDU) using a single fuse and set of power cables per load. Fuse panels shall not be "daisy chained" to the same source (sharing the same cable or fuse).
- 6.1.18 SPDUs may serve network elements outside the bay in which the fuse panel resides as long as it is within a close proximity of the fuse panel, and does not exceed the engineered limitation of the largest output cable the panel can accommodate. Exact distances will vary from panel to panel and overall shall not be outside of line-of-sight. Distances shall be calculated by determining the largest conductor physically attachable to the panel (tapping a larger cable to increase the distance is not acceptable), appropriate voltage drop, and List 2 DC amperage value to be used per fuse position.

6.2. Telecommunications Equipment Loads

- 6.2.1 The nominal voltage levels for standard telecommunications equipment are -48V. Although nominal voltages are standardized, the limits permitted on individual equipment assemblies are more variable. Voltage requirements are:
 - a) HIGH VOLTAGE LIMIT - Above this supply voltage, equipment damage may occur.
 - b) LOW VOLTAGE LIMIT - Below this supply voltage, equipment does not operate properly.
 - c) ELECTRONIC NOISE IMMUNITY - The power supply shall not exceed manufacturer's requirements and in no case exceed 35 dBmC.
- 6.2.2 The maximum allowable one way voltage drop from batteries to the served equipment via a BDFB/SPDU shall be 1.0 volt per reference drawing SBC-P-05410-E.
- 6.2.3 The DESP shall assure that the maximum allowable voltage drop from the battery to the served equipment is not exceeded. This voltage drop is an engineered value, based on the minimum volts per cell (MVPC) used in calculating battery requirements. Refer to the BDFB CO records in TAB/db & PowerPro for the engineered voltage drop values of each BDFB.

6.3. Protector And Cable Sizing

- 6.3.1 Overcurrent protection (fuses or circuit breakers) and secondary distribution cables are sized using List 2 current drain. List 2 current drain represents the peak current for a circuit under worst-case operating conditions. Worst case could be a constant power load requiring maximum current at minimum operating voltage.
- 6.3.2 The DESP shall determine the cable path and length, and then size the cable for the load at the maximum allowable voltage drop. The following formula applies:

$$CM = (11.1 \times L \times \text{Feet}) / V$$

Where:

CM = Circular Mil area of the cable

L = List 2 Drain
Feet = One-way length of cable in feet
V = Allowable voltage drop one way

See reference drawing SBC-P-05410-E.

- 6.3.3 The preferred engineering method of power connection is to use a non-interrupted conductor with connecting lugs at each end. Transitional devices shall only be used when no other solutions (such as narrow tongue lugs) are applicable.
- 6.3.4 The DESP shall engineer wiring connections to BDFB fuse posts to be $\leq 1/0$ (based on circuit ampacity, voltage drop requirements and connection accessibility); however, on legacy fuse panels in primary and secondary distribution bays, fuse post stiffeners shall be required for 1/0 connections.
- 6.3.5 Cables larger than #1/0 shall not be engineered into the interior of the BDFBs or secondary power distribution frames.
- a) For external return bar BDFBs, the return lead shall be engineered to be terminated without a reduction.
- 6.3.6 Fuse size shall be larger than the load on the cable. Multiply the List 2 load by 1.25 (125%) to determine the correct protector size. **Caution:** This does not apply to protectors at BDFB or Power Board which supply miscellaneous fuse panels as described previously under Power Distribution Sources. Once the protector is sized, assure the ampacity of the cable exceeds the rating of the protector. The cable size may be increased as necessary to meet the requirements for ampacity. The current capacity of the cable is usually only an issue with very short runs, since cables are sized first on voltage drop, then current capacity.
- 6.3.7 When adding circuit breakers to an existing PDU, the circuit breaker shall be, thermal-magnetic and 100% DC rated, UL listed, and the trip-free type. Contacts shall not be able to be held closed during an over-current condition, by holding the lever in the closed position.
- 6.3.8 A circuit breaker with a 100% rating can be loaded to the List 2 drain.
- 6.3.9 Circuit breakers not rated at 100% shall be larger than the load on the cable. Multiply the List 2 load by 1.25 (125%) to determine the minimum protector size.
- 6.3.10 Primary and secondary circuit protection devices shall be coordinated to prevent premature operation of primary fuses caused by faults on secondary circuits. The differential shall be approximately 20% per protection level.
- 6.3.11 Circuit breakers shall not be protected by fuses as circuit breakers typically have slower interrupt ratings. The exceptions are:
- a) If the network element rack comes pre-assembled;
- b) Where the circuit breaker is used as an on/off switch at the equipment
- 6.3.12 If paralleling of conductors or reinforcement of existing, overloaded conductors is required, they shall be electrically joined at both ends to form a single conductor. Paralleled conductors shall meet the following:

- a) Be the same length;
 - b) Have the same conductor material;
 - c) Be the same size in circular mils area;
 - d) Have the same insulation type;
 - e) Be terminated in the same manner and area;
 - f) Follow the same path.
- 6.3.13 All cartridge type fuses shall be DC rated, telecommunications power-style (e.g. TELPOWER®) for new installations and replacements, unless another type of fuse is specified in the applicable SBC Equipment or Power Drawing. Approved telecommunications power-style fuses are listed on the Minor Materials List and shall be used
- 6.3.14 All non-cartridge type fuses and circuit breakers shall be AC rated for AC circuits and DC rated for DC circuits.
- 6.3.15 Renewable link and H type fuses shall not be used.
- 6.3.16 Alarm pilot fuse applications other than the 0.18 amp GMT for Telpower fuse Blocks shall be 1/2 amp. (35 or 70 type).
- 6.3.17 All DC fuses shall be provided with a blown fuse indicator connected to an alarm circuit and indicating lamp within the bay.
- 6.3.18 All telecommunications power-style (e.g. TELPOWER®) fuse blocks equipped with a GMT alarm fuse circuit shall be equipped with a 0.18 amp fuse.
- 6.3.19 Dummy fuses shall be provided at all exposed, vacant fuse positions. (This includes GMT type and 70 type). It is not necessary to provide dummy fuses for enclosed cartridge type fuse blocks.
- 6.3.20 The DESP shall ensure that the correct type and quantity of fuse designation pins are provided for those fuse panels designed to accommodate fuse designation pins.
- 6.3.21 The DESP shall provide 10% spare fuses (minimum 1) of each size and type ordered up to 100 amps, and 25% spare fuses (minimum 1) of each size and type from 100 to 600 amps.
- 6.3.22 Only manufacturer approved fuse reducers may be used for exposed face fuse positions. In all other cases fuse reducers shall not be used.

TABLE 12-1 – SUMMARY OF CHANGES IN SECTION 12

Change	Item in 10/01/03 Issue	Item in This Issue
Revised	1.1.4	1.1.4
	1.2.6	1.2.5
	1.2.7	1.2.6
	1.2.8	1.2.7
	1.2.10	1.2.9
	1.2.11	1.2.10
	1.2.12	1.2.11
	1.2.14	1.2.13
	1.2.15	1.2.14
	1.2.16	1.2.15
	1.2.17	1.2.16
	1.2.18	1.2.17
	1.2.19	1.2.18
	2.2.1 a)	2.2.1 a)
	2.2.1 d) 1	2.2.1 d) 1
	2.2.1 d) 2	2.2.1 d) 2
	2.2.1 d) 3	2.2.1 d) 3
	2.2.1 d) 4	2.2.1 d) 4
	2.2.1 d) 5	2.2.1 d) 5
	2.2.2b)	2.2.2 b)
	2.3.1	2.3.1
	2.3.2	2.3.2
	2.3.3	2.3.4
	2.3.4	2.3.5
	2.3.5	2.3.6
	2.3.6	2.3.7
	2.3.7	2.3.8
	2.3.8	2.3.9
	2.3.9	2.3.10
	2.3.10	2.3.11
	2.3.11	2.3.12
	2.3.14	2.3.18
	2.3.15	2.3.19
	2.3.16	2.3.21
	2.4.6	2.4.6
	2.4.7	2.4.7
	2.4.8	2.4.8
	4.1.1	4.1.1
	4.1.2	4.1.2
	4.2.1	4.2.1
	4.2.2	4.2.2
	4.2.3	4.2.4
	4.2.4	4.2.5
	4.2.5	4.2.6
	5.1.2	5.1.3

DETAIL ENGINEERING REQUIREMENTS
SBC Local Exchange Carriers

Section 12, SBC-TP-76400
November 1, 2005

Change	Item in 10/01/03 Issue	Item in This Issue
Revised (Continued)	6.1.6	6.1.6
	6.1.7	6.1.7
	6.1.9	6.1.10
	6.1.10	6.1.11
	6.1.11	6.1.12
	6.1.12	6.1.13
	6.1.13	6.1.14
	6.1.15	6.1.17
	6.1.16	6.1.18
	6.2.1	6.2.1
	6.2.2	6.2.2
	6.3.2	6.3.2
	6.3.3	6.3.3
	6.3.4	6.3.4
	6.3.5	6.3.5
	6.3.6	6.3.11
	6.3.7	6.3.12
	6.3.8	6.3.13
	6.3.9	6.3.14
	6.3.10	6.3.15
	6.3.11	6.3.16
	6.3.12	6.3.17
	6.3.13	6.3.18
	6.3.15	6.3.19
	6.3.16	6.3.21
	6.3.17	6.3.22
Deleted	1.2.5	
	1.2.9	
	6.3.14	

Change	Item in 10/01/03 Issue	Item in This Issue
Added		1.2.8 1.2.12 2.2.1 d) 3 2.2.1 d) 4 2.2.1 d) 5 2.3.3 2.3.8 a) 2.3.13 2.3.14 2.3.15 2.3.16 2.3.17 2.3.20 5.1.2 6.1.8 6.1.15 6.1.16 6.3.3 6.3.4 6.3.5 6.3.6 6.3.7 6.3.9 6.3.10

FIGURE 12-1--POWER SYSTEM

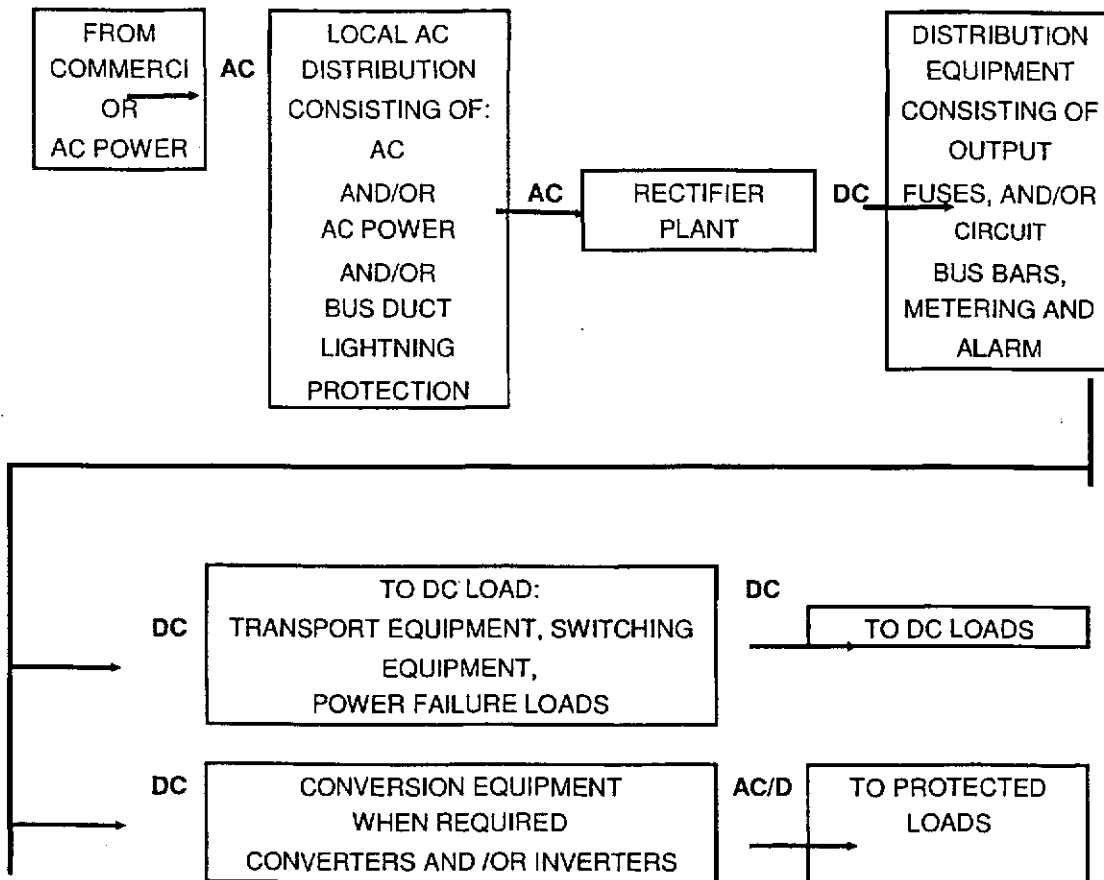


FIGURE 12-2-RECTIFIER PLANT

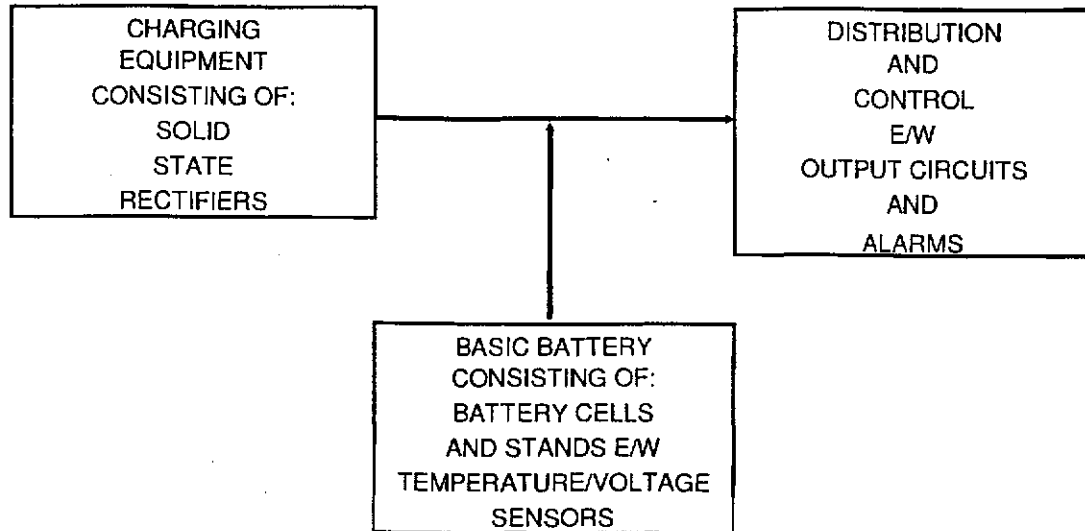
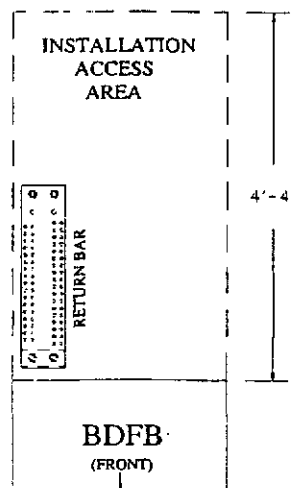


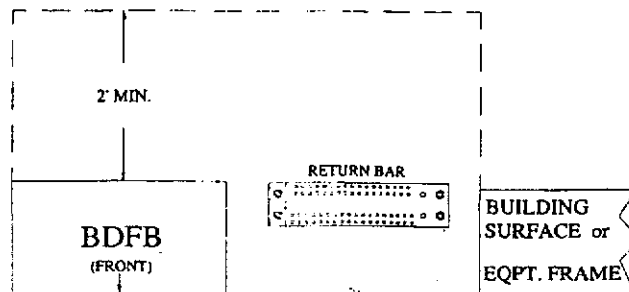
FIGURE 12-3 – BDFB EXTERNAL BATTERY RETURN BAR PLACEMENT (TOP VIEWS)

PREFERRED LOCATION



EXTERNAL RETURN BAR - REAR MOUNT

OPTIONAL LOCATION



EXTERNAL RETURN BAR - SIDE MOUNT

[END OF SECTION]